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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/816,989	04/01/2004	Ju-Cheol Shin	2522-055	2017
20575	7590	08/15/2005	EXAMINER	
MARGER JOHNSON & MCCOLLOM, P.C. 210 SW MORRISON STREET, SUITE 400 PORTLAND, OR 97204			LEE, CALVIN	
			ART UNIT	PAPER NUMBER
			2818	

DATE MAILED: 08/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/816,989

Applicant(s)

SHIN et al.

Examiner

Lee, Calvin

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 8-13 is/are rejected.
- 7) ☒ Claim(s) 7 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 5/27/05
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

## OFFICE ACTION

### *General Information*

1. The drawings dated 4/01/04 and the IDS dated 5/27/05 have been approved.

### *Claim Rejections - 35 U.S.C. § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3, 6, 8-9, and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over *APA* (Applicant's Prior Art) in view of *Maruyama et al* (US 2004/0132265).

*APA* discloses a method of manufacturing a semiconductor device:

- forming a photoresist pattern on a tungsten layer formed on a substrate [pg. 1, ln.30];
- selectively etching the tungsten layer using the photoresist pattern as an etching mask to form a tungsten layer pattern on the substrate [pg. 1, ln.33]; and removing the photoresist pattern;
- forming a tungsten oxide layer on the tungsten layer pattern by thermal treatment [pg. 2, ln.1];
- thermally treating the substrate [pg. 2, ln.3].

a) In re claim 9, *APA* suggests removing the photoresist by an ashing process or a stripping process [pg. 1, ln.34].

b) In re claim 13, *APA* inherently teaches an insulating layer formed on the substrate including the tungsten pattern [pg. 2, ln.15].

c) *APA* however fails to disclose the step of introducing a source gas including silicon onto the tungsten layer pattern to form a protecting layer that prevents an abnormal growth of oxide. *Maruyama et al* discloses, “silane gas and N<sub>2</sub>O gas are used in the sample G” [Fig. 16B and ¶ 0090]. According to this cited experiment/sample of *Maruyama et al*, the metal oxide is naturally formed by preferential oxidative reaction of oxygen and tungsten due to oxygen gas used for forming the film [¶ 0089]. However, if silane (SiH<sub>4</sub> including not only silicon but also hydrogen) is used for forming a protective film [¶ 0091], the metal oxide is not detected by the reduction of the silicon oxide film (i.e., preventing an abnormal growth of oxide) formed between the tungsten film and silicon oxide film (i.e., the native oxide) due to hydrogen found in the silane gas [¶ 0090].

Therefore, *APA* in view of *Maruyama et al* teaches or suggests introducing a source gas including silicon onto the oxidized surface of the tungsten layer pattern to form a protecting layer.

It would have been obvious to one having skills in the art to have modified the process of Applicant's Prior Art by utilizing a silane-gas treatment for the purpose of reducing a growth of oxide, as taught by *Maruyama et al* [¶ 0090, ln.5].

d) In re claims 6 and 12, neither *APA* nor *Maruyama et al* teaches or suggests the protecting layer having a thickness of about 1Å to about 100Å.

It would have been an obvious matter of design choice to have the claimed layer thickness, since such a modification would have involved a mere change in the size of the protecting layer. A change in size is generally recognized as being within the level of ordinary skill in the art. *In re Rose*, 105 USPQ 237 (CCPA 1955).

4. Claims 4 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art and *Maruyama et al* in view of *Ludwig et al* (US 2002/0098648), and further in view of *Hashimoto et al* (US 6,022,586).

The combination of *APA* and *Maruyama et al* is silent about a silane flow rate and its correspondent temperature. *Ludwig et al* discloses, "the tungsten-containing layer is converted into a tungsten oxide layer ... when using a pure tungsten layer, the temperature should not exceed approximately 600°C" [¶ 0061]. *Ludwig et al*, however, is silent about a silane flow rate. *Hashimoto et al*, teaching a heat treatment in the presence of silane-series gas, suggests "if the wafer is heated to a process temperature of 700°C, the SiH<sub>4</sub> gas and the PH<sub>3</sub> gas ... are supplied at rates of about 150sccm and about 400sccm, respectively" [col. 11, ln.11].

It would have been obvious to one having skills in the art to have modified the protecting film formation of *APA* and *Maruyama et al* by utilizing the claimed silane flow rate and the formation temperature because one would adjust formation temperature and/or gas flow rate to result in the most effective protecting layer formation.

5. Claims 5 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art and *Maruyama et al* in view of *Ludwig et al*.

The combination of *APA* and *Maruyama et al* is silent about the substrate being thermally treated at a temperature of about 300 to about 1100°C. Nevertheless, such thermal treatment is known in the semiconductor processing art as evidenced by *Ludwig et al* disclosing "a subsequent heat treatment at a temperature of 550 to 1100°C ... after the tungsten oxide layer has been produced" [¶ 0065].

It would have been obvious to one having skills in the art to modify the thermal treatment of Applicant's Prior Art and *Maruyama et al* by utilizing a thermal treatment at the claimed temperature for the purpose of transforming the tungsten oxide into a crystalline or sintered phase.

***Allowable Subject Matter***

6. Claim 7 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim because *Hashimoto et al* (US 6,022,586) discloses introducing silane gas for allowing silicon to be deposited on the surface of the tungsten silicide [col. 10, ln.38], but not implanting silicon ions to the oxidized surface of the tungsten layer. On the other hand, *Maruyama et al* fails to teach applying energy to the source gas to form silicon ions.

***Contact Information***

7. Any inquiry concerning this communication from the Examiner should be directed to *Calvin Lee* at (571) 272-1896 on Mondays thru Thursdays 6:30-4:30PM. If attempts to reach the examiner by telephone are unsuccessful, Art Unit 2818's Supervisory Patent Examiner *David Nelms* can be reached at (571) 272-1787. The fax phone number for the organization (where this application is assigned to) is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system at <http://pair-direct.uspto.gov>. Should you have questions on access to the PAIR system, contact the Electronic Business Center at (866) 217-9197.



Calvin Lee